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was upsetting the very foundations upon which heating and ventilating science was built.

It seems as if there must be somewhere in existence the knowledge which we need at the present time. Man has become in a comparatively few years a preeminently house-abiding creature. He lives in localities which are paved, where there is little opportunity for evaporation, which is a necessary condition for human living. Present conditions are not right. Does any one know in what respect our present schemes of ventilation are wrong, why delicate children and tuberculous persons get well out of doors, and fail to do so in-doors, and what we need to do to make in-door living as healthy as out-door living? If we can find the answers to these questions we shall have discovered something which will affect the vitality of all the children, and ultimately of all the adults, who live in buildings throughout the civilized world.

Any reference to original sources which any of your readers can give will be most gratefully welcomed.

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"MUTATIONS" OF WAAGEN AND "MUTATIONS"
OF DE VRIES OR "RECTIGRADATIONS" OF
OSBORN

It is important to distinguish clearly between what may be called the "mutations" of Waagen, the "mutations" of De Vries, and the rectigradations of Osborn. By careful examination of Waagen's original paper and the usage of this paper on the continent by subsequent paleontologists it appears certain that the mutations of Waagen are stages of transition between Linnæan species occurring in direct lines of phyletic ascent. These stages are distinguished by progress, although perhaps very slight in a number of different characters. The mutations of De Vries have not been distinguished in paleontology, but only in botany, and through botany extended to zoology. They represent the sudden or discontinuous jumps or saltations through which new characters arise. Definite direction is given to these characters only through selec-

tion. The "rectigradations" of Osborn are different in significance from either of the above; the term refers to the stages of single new characters occurring at definite points, hence originally termed by Osborn "definite variations." The mutations of De Vries can not be used by paleontologists, with whom the original term *saltation* would be preferable.

HENRY FAIRFIELD OSBORN

SCIENTIFIC BOOKS

Inheritance of Characteristics in Domestic Fowl. By CHARLES B. DAVENPORT. Carnegie Institution of Washington, Publication No. 121. Pp. i + 100, Pl. 1-12. 1909. Issued February 7, 1910.

This quarto volume contains a detailed account of the results of the continuation of the studies on inheritance in domestic poultry carried out by Dr. Davenport at the Station for Experimental Evolution at Cold Spring Harbor, the first instalment of the results of these investigations having appeared as Carnegie Institution Publication No. 52. A great mass of new and interesting facts are brought forth in the present work. The book is divided into twelve chapters, of which the first eleven deal severally with some of the characters which experience shows to be most difficult of definite analysis in respect to their hereditary behavior. Nearly every character discussed is one which at first acquaintance appears not at all to follow Mendelian principles (at least in their simplest form) in inheritance. Because of this fact they are of all the greater interest and significance to the student of heredity, and any systematic and thorough attempt at their analysis, such as is here made, is most heartily to be welcomed and commended, even though one may not be prepared to accept *in toto* the final interpretations reached. The extensive collection of facts brought together in this work loses none of its value if the theoretical interpretation should later be changed.

Chapter I. deals with the inheritance of the split or Y comb which appears in the progeny of a cross between a single-combed bird and one possessing a V or "horned" comb, such as

is found in the Polish fowl. The essential facts brought out are that the proportion of the median element to the lateral elements of the Y comb varies in the F_1 progeny all the way from 0 to 90 per cent. of median element. In the F_2 and subsequent progeny the amount of median element is distinctly correlated with the amount present in the parents. The author's interpretation of this is that median comb is imperfectly dominant over no-median comb, and that the degree (or potency) of dominance is inherited. Chapter II. deals with the inheritance of the extra toe found in various breeds of fowls. The facts here are that while "extra toe" is sometimes dominant, it sometimes fails to dominate. Lumping all statistics together, it would appear to be the case that the greater the degree of dominance of extra toe in F_1 the higher the proportion of polydactylous young produced in subsequent generations, thus apparently confirming Castle's conclusions regarding the inheritance of degrees of polydactylism in guinea-pigs. Analysis of the data with reference to gametic constitution of the parents, however, leads plainly to the conclusion that "the average condition of toes in the offspring of second or later generation hybrids can not be used as evidence of inheritance of the degree of parental development of the toes, since these are dependent upon the same basal cause, namely, the hidden gametic constitution of the parents."

Chapter III. deals with syndactylism, or "web foot" condition. This character apparently segregates as though it were dominant to normal foot, though the dominance itself may fail to appear in F_1 . Chapter IV. deals with rumplessness, a character of certainly puzzling behavior in inheritance. Here the author's earlier provisional conclusion that rumplessness is recessive is reversed, and now this condition is held to be dominant, the allelomorphs being "inhibitor of tail" and its absence. The principle of imperfection of dominance is adduced to explain the fact that the F_1 progeny are tailed. Some data regarding the inheritance of presumably congenital winglessness are given in the next chapter,

but definite conclusions are not reached. The next two chapters present some very valuable evidence on the much-mooted problem of the effectiveness of selection of fluctuating variations. The characters dealt with are booting (feathering of legs) and nostril form. The facts here are of great importance and almost unique in the literature in that *they give for a bisexual organism data as to definite grades of the character in individuals of known gametic constitution with respect to this character*. The results show at once the inherent fallacy of the basic assumption of the biometric method of dealing with inheritance, which tacitly assumes that all somatic variations are of equal hereditary significance,¹ and at the same time the failure of selection of fluctuating variations within a *genetically homogeneous* population (= the nearest thing to a "pure line" one can ever get in a bisexual organism) to produce any result. If all degrees of booting in parent and offspring of all sorts of gametic constitution are lumped together in one table there is a sensible correlation between parent and offspring. One might hence conclude that grades of booting are inherited in a blending fashion, and could be genetically modified by systematic selection of slight "favorable variations." If, however (and in showing this with such precision and clearness lies one of the most valuable contributions of the work), a table is made in which the individuals included are homogeneous gametically there is no correlation whatsoever between parent and offspring in respect to grade of booting. The offspring of parents with "much boot" have on the average no more of the character than those whose parents have "little boot," provided both sets of parents are gametically alike as regards "booting." Under these circumstances one would obviously not make progress in selecting for increased booting. Nostril form shows the same thing.

The next two chapters deal with crest

¹ Cf. a more detailed discussion of this point in a paper entitled "Biometric Ideas and Methods in Biology: Their Significance and Limitations," which is shortly to appear in "Scientia."

(showing that this structure depends upon two gametic characters, instead of one as hitherto supposed), and with comb-lop (showing that the direction of the lop is not apparently inherited). Chapters X. and XI. deal with various phases of the inheritance of plumage, color and pattern. A general gametic formula for poultry coloration is worked out and evidence presented in its favor. Data are given regarding the inheritance of certain pattern types.

The last chapter is devoted to a general discussion of certain theoretical matters of prime importance. Stress is laid upon the possible significance of "inhibitors" in addition to "determiners" in ontogeny. The "principle of imperfect dominance" is discussed at length. One fancies that here is where the greatest disagreement will be found amongst students of the subject. The reviewer, frankly, is unable to see that degree of heuristic worth in this concept which the author seems to find. It seems possible to account for all the facts on which this concept rests in other ways, not any the less in accord with Mendelian principles. Virtually these facts amount to an *apparent* failure of segregation. One may safely say that practically all students of inheritance whose study involves a real, first hand acquaintance with the living, breeding organisms are deeply impressed with the precision and definiteness of segregation *generally*. When apparent exceptions to the law of precise segregation occur one's zeal is aroused to discover the cause. There is a wide range of physiological factors beyond such things as "imperfection of dominance" which must be considered here (*teste* the work of Tower and of Tennent, for example). Probably every one will admit that the data now available do not permit any final conclusion as to what are the primary factors involved in causing apparent exceptions to Mendelian principles, either in general or in particular cases. What clearly are needed are more of such extensive collections of definite experimental data as are furnished in the work under discussion. We may well observe that caution expressed by Robert Boyle as an apol-

ogy for not taking a more decided stand on theoretical questions: "having met with many things for which I could assign no probable cause, and with some for which many different ones might be alleged, I dare speak positively and confidently of very few things except of matters of fact."

RAYMOND PEARL

The Teaching Botanist. A Manual of Information upon Botanical Instruction. By WILLIAM F. GANONG, Ph.D., Professor of Botany in Smith College. Second edition. Pp. 12 + 439, illustrated. New York, The Macmillan Company. 1910.

At a time when the teaching profession is being assailed on all sides with demands for a practical education, and when the meaning of "practical" is, in the main, materialistic, those teachers in botany still committed to ideals, but perhaps finding difficulty in harmonizing them with the proper demands of those seeking immediately useful training, will find a champion in the author of "The Teaching Botanist." Professor Ganong has worked long and consistently with the avowed purpose of trying to solve the problem of the content and method of an elementary course in botany. He may therefore be looked upon by the teacher seeking guidance as among the safest and surest. He would be the first to disavow the claim that he has quite answered the question to which his book is a large and satisfying reply, but we do not hesitate to say that he is far along on the right track.

"The Teaching Botanist" in its present form is called a second edition, but is very largely a rewriting. On the side of information, which the teaching botanist desires to have respecting the materials with which he deals, it has been brought down to date. The results of actual teaching experience during the last few years have been set down. In this sense the book is practical, in some directions almost encyclopedic, and will stand in good stead to one who is planning courses or equipping a laboratory. This will be understood to include also the matter of books, which are well discussed, and of which a full